Are Cars or Trees More Important to Particulate Matter Air Pollution? What Radiocarbon Measurements Have to Say

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Air pollution in the form of particulate matter (PM) originates from both human activities and "natural" phenomena. Setting and achieving National Ambient Air Quality Standards (NAAQS) for PM has to take into account the latter since they are in general less controllable than the former. One of the elusive contributors to "natural" PM, particularly during summertime, is biogenic secondary organic aerosol (SOA), which results in the formation of PM from atmospheric gas-to-particle conversion of volatile organic compounds (VOC) emitted by vegetation. Theoretical estimates of the importance of biogenic SOA as a component of summertime PM differ greatly, ranging from negligible to dominant, because of uncertainties in both the conversion mechanism and the amount and characteristics of biogenic VOC emissions. However, quite direct experimental estimates can be obtained by measuring the amount of the naturally occurring radioactive isotope ^{14}C (radiocarbon) in a PM sample. The method depends on the tiny but nearly constant fraction of ^{14}C relative to ordinary carbon (^{12}C) in all living and recently living material, and its absence in fossil fuels. Beginning a few years ago a series of fine PM (PM-2.5) summertime samples are being collected at various sites in the Southeastern U.S. for subsequent radiocarbon measurement, including collaboration with the State of Texas in Houston and the State of Florida in Tampa. Initial results indicate a surprisingly large carbonaceous biogenic fraction—approximately one half—presumably in large part from SOA. If the initial results are representative, this finding has serious implications for PM-2.5 control and standard setting.

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